[217] Attorney Docket No. : CGW-263.1 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Nicholas F. Borrelli, Thomas P. Seward III, and Charlene M. Smith
Appl. No.	:	Not Yet Assigned
Filed	:	Simultaneously Herewith
For	:	SILICA WITH LOW COMPACTION UNDER HIGH ENERGY IRRADIATION

Commissioner of Patents and Trademarks
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Prior to its initial examination, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Please replace the paragraph which appears at page 1, lines 4-8, of the specification with the following:

This application is a divisional of U.S. Application No. 09/254,114 filed February 25, 1999, which is the U.S. national phase under 35 USC §371 of International Application No. PCT/US97/15233 filed August 27, 1997, which was published in English under PCT Article 21(2) on March 5, 1998 as International Publication No. WO 98/08775. This application claims the benefit under 35 USC §119(e) of U.S. Provisional Application No. 60/024995, filed August 29, 1996. The contents of U.S. Applications Nos. 09/254,114 and 60/024,995 and International Application No. PCT/US97/15233 are incorporated herein by reference in their entireties. The invention relates to stepper lens from fused silica having low compaction under

high energy irradiation, particularly adaptable for use in photolithography applications at wavelengths of 193 and 248 nm.

A copy of original paragraph annotated to show the changes made by this amendment is attached as Exhibit A.

IN THE CLAIMS:

Please amend the claims as follows:

1. Cancel, without prejudice, Claims 1 and 5;

2. Amend Claims 2-4 as set forth below.

3. Add Claims 6-11.

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2. (amended) A method for producing a fused silica stepper lens which is resistant to compaction when exposed to high intensity excimer radiation comprising the steps of:

(a) preparing a solution which contains at least one silicon-containing organic compound having the formula $Si(OR)_4$ or $SiR(OR)_3$, where R is an alkyl group;

(b) polymerizing the silicon in the solution to form a SiO_2 gel;

(c) drying the gel at a rate which causes the gel to fragment into granules having a mean particle size less than about one millimeter;

(d) sintering the granules at a temperature less than about 1150°C, the density of the granules after sintering being approximately equal to their maximum theoretical density;

(e) forming a green body from the sintered granules;

(f) drying and partially sintering the green body in a chamber by (i) raising the temperature of the chamber to above about 1000°C, and (ii) introducing chlorine gas into the chamber and/or subjecting the chamber to a vacuum and/or purging the chamber with an inert gas;

(g) fully sintering the green body in a chamber by raising the temperature of the chamber to a temperature above about 1720°C, while purging the chamber with helium or applying a vacuum to the chamber; and

(h) producing the stepper lens using the fully sintered green body formed in step (g).

3. (amended) The method according to claim 2 wherein the process includes the additional step after step (g) and before step (h) of hot isostatic pressing the fully sintered green body in a chamber by raising the temperature of the chamber to above about 1150°C and introducing an inert gas into the chamber at a pressure above about 100 psig.

4. (amended) The method according to claim 2 wherein the solution of step (a) contains tetraethylorthosilicate having the formula $Si(OC_2H_5)_4$.

6. A method for producing a fused silica stepper lens which is resistant to compaction when exposed to high intensity excimer radiation comprising the steps of:

(a) preparing a solution which contains at least one silicon-containing organic compound having the formula $Si(OR)_4$ or $SiR(OR)_3$, where R is an alkyl group;

(b) polymerizing the silicon in the solution to form a SiO_2 gel;

(c) drying the gel at a rate which causes the gel to fragment into granules having a mean particle size less than about one millimeter;

(d) sintering the granules at a temperature less than about 1150°C, the density of the granules after sintering being approximately equal to their maximum theoretical density;

(e) forming a green body from the sintered granules;

(f) drying and partially sintering the green body in a chamber by (i) raising the temperature of the chamber to above about 1000°C, and

(ii) introducing chlorine gas into the chamber and/or subjecting the chamber to a vacuum and/or purging the chamber with an inert gas;

(g) fully sintering the green body in a chamber by raising the temperature of the chamber to a temperature above about 1720°C, while purging the chamber with helium or applying a vacuum to the chamber; and

(h) producing the stepper lens using the fully sintered green body formed in step (g).

wherein said method also comprises:

(i) exposing a sample of fused silica made by steps (a) through (g) to high intensity excimer radiation; and

(j) determining the resulting compaction of said sample.

7. The method according to claim 6 wherein:

the process includes the additional step after step (g) and before step (h) of hot isostatic pressing the fully sintered green body in a chamber by raising the temperature of the chamber to above about 1150°C and introducing an inert gas into the chamber at a pressure above about 100 psig, and

steps (i) and (j) are performed after the hot isostatic pressing.

8. The method according to claim 6 wherein the solution of step (a) contains tetraethylorthosilicate having the formula $Si(OC_2H_5)_4$.

9. A process comprising:

(I) producing a fused silica stepper lens which is resistant to compaction when exposed to high intensity excimer radiation by a method comprising:

(a) preparing a solution which contains at least one silicon-containing organic compound having the formula $Si(OR)_4$ or $SiR(OR)_3$, where R is an alkyl group;

(b) polymerizing the silicon in the solution to form a SiO_2 gel;

(c) drying the gel at a rate which causes the gel to fragment into granules having a mean particle size less than about one millimeter;

(d) sintering the granules at a temperature less than about 1150°C, the density of the granules after sintering being approximately equal to their maximum theoretical density;

(e) forming a green body from the sintered granules;

(f) drying and partially sintering the green body in a chamber by (i) raising the temperature of the chamber to above about 1000°C, and (ii) introducing chlorine gas into the chamber and/or subjecting the chamber to a vacuum and/or purging the chamber with an inert gas;

(g) fully sintering the green body in a chamber by raising the temperature of the chamber to a temperature above about 1720°C, while purging the chamber with helium or applying a vacuum to the chamber; and

(h) producing the stepper lens using the fully sintered green body formed in step (g); and

(II) using the stepper lens formed in step (h) to perform photolithography.

10. The method according to claim 9 wherein the process includes the additional step after step (g) and before step (h) of hot isostatic pressing the fully sintered green body in a chamber by raising the temperature of the chamber to above about 1150°C and introducing an inert gas into the chamber at a pressure above about 100 psig.

11. The method according to claim 9 wherein the solution of step (a) contains tetraethylorthosilicate having the formula $Si(OC_2H_5)_4$.

A copy of original Claims 2-4 annotated to show the changes made by this amendment is attached as Exhibit B.

Entry of this amendment prior to the calculation of the filing fee for this application is respectfully requested.

Respectfully submitted,

Date: 10/26/01

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Exhibit A
Annotated Copy of Amendment to the Specification

Page 1, lines 4-8

This application is a divisional of U.S. Application No. 09/254,114 filed February 25, 1999, which is the U.S. national phase under 35 USC §371 of International Application No. PCT/US97/15233 filed August 27, 1997, which was published in English under PCT Article 21(2) on March 5, 1998 as International Publication No. WO 98/08775. This application claims [priority to U.S. provisional application no.] the benefit under 35 USC §119(e) of U.S. Provisional Application No. 60/024995, filed August 29, 1996. The contents of U.S. Applications Nos. 09/254,114 and 60/024,995 and International Application No. PCT/US97/15233 are incorporated herein by reference in their entireties. The invention relates to stepper lens from fused silica having low compaction under high energy irradiation, particularly adaptable for use in photolithography applications at wavelengths of 193 and 248 nm.

Exhibit B
Annotated Copy of Amendment to Claims 2-4

2. (amended) A method for producing a fused [Fused] silica stepper lens which is resistant to compaction when exposed to high intensity excimer radiation [, said lens being made by a process] comprising the steps of:

(a) preparing a solution which contains at least one silicon-containing organic compound having the formula [$SI(OR)_4$] $Si(OR)_4$ or $SiR(OR)_3$, where R is an alkyl group;

(b) polymerizing the silicon in the solution to form a SiO_2 gel;

(c) drying the gel at a rate which causes the gel to fragment into granules having a mean particle size less than about one millimeter;

(d) sintering the granules at a temperature less than about 1150°C, the density of the granules after sintering being approximately equal to their maximum theoretical density;

(e) forming a green body from the sintered granules;

(f) drying and partially sintering the green body in a chamber by (i) raising the temperature of the chamber to above about 1000°C, and (ii) introducing chlorine gas into the chamber and/or subjecting the chamber to a vacuum and/or purging the chamber with an inert gas; [and]

(g) fully sintering the green body in a chamber by raising the temperature of the chamber to a temperature above about 1720°C, while purging the chamber with helium or applying a vacuum to the chamber; and

(h) producing the stepper lens using the fully sintered green body formed in step (g).

3. (amended) The method [Stepper lens] according to claim 2 wherein the process includes the additional step after step (g) and before

step (h) of hot isostatic pressing the fully sintered green body in [to] a chamber by raising the temperature of the chamber to above about 1150°C and introducing an inert gas into the chamber at a pressure above about 100 psig.

4. (amended) The method [Stepper lens] according to claim 2 wherein the solution of step (a) contains tetraethylorthosilicate having the formula $Si(OC_2H_5)_4$.